Dental Anesthesiology: Its History and Continuing Evolution

NIELS BJORN JORGENSEN 2nd MEMORIAL LECTURE

Edward J. Driscoll, DDS†

It is with interest and amusement that I recall vividly from Dr. Jorgensen's memoirs his story about walking down Market Street in San Francisco on the second day of his enrollment at the University of California Dental School in August of 1919.[1] His curiosity was aroused by a large crowd gathered to listen to a street lecture being delivered by the notorious California dentist, Dr. "Painless" Parker. Even in 1919, the public interest in dental pain was intense and genuine. It most certainly remains so today.

During Dr. Jorgensen's more reflective moments about his life's dedication (patient comfort), he frequently expressed discouragement and disappointment at the slow pace of progress. He wondered with some justification whether dental anesthesiology (pain control)* as a discipline would ever become a reality. Movement toward this goal is clearly visible; not enough to be sure, but definite progress can be reported. Most of the early inertia has been overcome due to the tenacity, courage, and patience of such pioneers in dental anesthesiology as Niels Jorgensen, Harold Krogh, Leonard Monheim, Ardian Hubbell and others.

Although I was not present when the first Jorgensen Memorial Lecture was delivered about a year ago by Dr. Jess Hayden Jr.[2] I did read the manuscript. The lecture was noteworthy not only for its lucid presentation of the historical development of dental anesthesiology but also for its fascinating insights into the character and contributions of Dr. Jorgensen. Dr. Jorgensen was a great humanitarian, a gentleman of the old school, a knowledgeable teacher, a clinical scientist, and a scholar in the truest sense of the word. In addition to all of these attributes, he was a most persistent man. We can appreciate the value of such persistence, for without that virtue, Niels' idea of "patient comfort" or "pain control" as it is presently called, would most certainly not be where it is today. Recall that it was almost 30 years ago that Dr. Jorgensen's concept of a separate and distinct section on anesthesiology in dental schools was recognized as important and actually implemented at Loma Linda. Yet in 1977, there are still only four dental schools which have a separate department and less than ten in which there is a distinct unit for the teaching of dental anesthesiology. Recall also that the Jorgensen (Loma Linda) technique, designed and introduced specifically for intravenous psychosedation in dentistry has proven safe and effective beyond any doubt. The technique, however, still has a far too limited sphere of usage. Based on 30 years of experience in dental anesthesiology I know how even minor innovations meet strong opposition and how slowly progress is achieved. Without the type of quiet persistence exemplified by Dr. Jorgensen, we would not be where we are today.

We have been reminded that Dr. Jorgensen did not recognize a dichotomy between clinical and academic pursuits.[2] In that same spirit, I dedicate this 2nd memorial lecture: Dental Anesthesiology, Its History and Continuing Evolution; an overall consideration of pain control in terms of its three fundamental components, i.e., research, teaching, and clinical practice. The problems related to each component of this triad, and the interdependence of each on the others are at the core of this discussion on the history and evolution of pain control in dentistry. The degree to which these problems are understood and resolved will determine the future of dental anesthesiology.

There being no greater teacher than historical experience, we might first examine and briefly discuss some specific aspects of a closely related discipline, medical anesthesiology. In this manner, we can identify and study advances common to both medical and dental anesthesiology: specific clinical events such as the discovery and introduction of new agents and techniques; new research and educational achievements and other key events that have had a major impact on the development of medical anesthesiology. Is it not reasonable to assume that these milestones would exert a similar influence on the course and evolution of dental anesthesiology?

With the discovery and first clinical demonstrations in the 1840's that both nitrous oxide and ether pro-

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*In dental parlance this term is frequently used to cover the entire subject of the control of iatrogenic pain and associated fear, dread and anxiety.

†Chief, Anesthesiology Section, Neurobiology & Anesthesiology Branch National Institute of Dental Research. Bethesda, Maryland 20014.

duced insensibility to pain, general anesthesia came into being. Drs. Horace Wells and William G. Morton, both dentists, are listed as the co-discovers of "anesthesia". Both the American Dental Association in 1864 and the American Medical Association in 1870, after years of long and heated debate, named Horace Wells, as the official discoverer of general anesthesia.[3] Dentists were also well represented in the early technical evolution of general anesthesia, particularly with regard to the invention and development of improved equipment. Two dentists, C.K. Teter and J.C. Heidbrink and a physician, E.I. McKesson, were responsible for the apparatus allowing the addition of oxygen to gas mixtures and for improving the effectiveness of devices for the control of oxygenation.[3] Controlled oxygenation represented the first scientific innovation in general anesthesia and was developed as a specific safety measure. The devices made possible the use of nitrous oxide and oxygen in a wide variety of surgical operations in the hospital. They also made possible the widespread use of nitrous oxide and oxygen by dentists in office practice during the first three or four decades of the twentieth century.

Despite the involvement of dentists along with physicians in the discovery and early development of general anesthesia, each profession went its separate way in anesthesia practice in the early part of this century. The path that dentistry took was strewn with many pitfalls. One especially the profession would very much like to forget: the hypoxic use of nitrous oxide by dentists. Paradoxically, this misuse for over 50 years clearly established that nitrous oxide is an extremely valuable and versatile agent and remarkably safe even when abused. There was morbidity to be sure and some mortality, but not at a rate one might have expected. There were an estimated one hundred thousand general anesthetics administered in New York City alone, as recently as 1955.[4]

This situation with respect to nitrous oxide occurred because general anesthesia was employed by dentists merely as a technique; sometimes with considerable art but rarely with a proper scientific appreciation. An object lesson should be derived from this historical experience so that the same error is not repeated. Intravenous sedation and other modern pain control modalities must never be considered only as techniques without awareness of their fundamental scientific aspects. Dentists should be discouraged from seeking out pain control courses designed to instruct in the use of a single drug or techniques. There are unfortunately far too many dentists today who ask, "where can I learn to use diazepam intravenously; or various combinations of intravenous agents and techniques"? rather than "where can I learn the scientific basis, as well as the art, of intravenous administration, as a integral part of anesthesia training"? In addition, dentists desiring to employ agents and drugs approved for hospital use but as yet incompletely tested in ambulatory dental and oral surgery situations, should be similarly cautious.

First Department of Anesthesiology — 1923

In regard to the previously mentioned medical-dental divergence that occurred in the development of general anesthesia during the early part of the century, progress in medical-anesthesiology did not accelerate, until a few pioneer physicians had the wisdom to introduce an innovation in the educational system; separate departments of anesthesia in the medical schools. In these departments, the entire substance of the infant specialty, graduate and undergraduate teaching and training, clinical practice and beginning research endeavors could all be organized and supervised by a single individual, the department chief.

Just a little over fifty years ago Ralph Waters founded the first department of anesthesiology at Wisconsin followed very shortly by John Lundy at the Mayo Clinic and Henry Beecher at Harvard. These events marked the beginning of the development of medical anesthesia as a scientific discipline and as a clinical specialty.[5] There is little doubt that until separate anesthesia departments or similar educational units are developed in dental schools and teaching hospitals providing far more opportunities than now are available for post doctoral clinical and research experience, dental anesthesia will remain in its present underdeveloped state.[6]

The establishment of departments of anesthesia was clearly the beginning of professionalism in medical anesthesiology. Such departments not only provided a focus for the activity in the medical school and the university hospital but even more importantly a structure was provided to produce better clinicians and future investigators and teachers. The structure of an anesthesiology department also encouraged the identification and investigation of deficiencies in the underlying science base; for example, early studies were conducted on the effects of anesthetic drugs on physiological performance and finding better ways to deal with the related clinical problems. *The Journal of the International Anesthesia Research Society*, linked to the university based department movement, was founded in 1922 and provided the first forum for publication of clinical, educational and research material.

New and valuable drugs like cyclopropane, ethylene, and sodium pentothal were introduced in the ensuing decades and more refined techniques for anesthesia administration and monitoring were devised, all within the framework of the educational and research atmosphere of medical departments of anesthesia. A second major journal, *Anesthesiology*, was founded in 1940 and subsequently envolved from a primarily clinical journal to the first-rate broad-gauged clinical, academic and scientific journal that it is today.

American Board of Anesthesiology — 1941

Other specific events exerted a profound effect on the continuing development of medical anesthesiology to its present status as a recognized specialty of medicine. Until 1940 the overall clinical and training problems in anesthesiology were considered under the

broad umbrella of the American Board of Surgery. In 1941, anesthesiology was recognized as an entity, and the American Board of Anesthesiology was established. This Board, as do all other specialty boards, has the continuing responsibility of setting educational and clinical standards and for insuring that these standards are stringently maintained and often upgraded.

The Era of Research Development (1950-Present)

A major evolutionary change occurred in the 50's. Research was recognized by many academic anesthesiologists as the most important single element leading to the further development of anesthesiology as a medical science and speciality. This followed the renewed interest in and a realization of the innate importance of basic science to the understanding of anesthetic related clinical problems that emerged in the late 40's and early 50's.

A concomitant significant development during the 50's was the initiation by the NIH-PHS of grant supported activities. First was the training and fellowship program established by Congress in 1957, which encouraged investigators in the medical sciences to study fundamental problems in anesthesiology. This and subsequent programs can be credited with the initiation of research training and endeavors ultimately involving literally thousands of investigators and graduate students. A second powerful stimulus was the authority granted by Congress to the General Medical Sciences Institute of the NIH to grapple with critical problems in clinical anesthesia, as recommended by a NIH-PHS blue-ribbon panel named specifically in 1965 to study clinical deficiencies described by the panel as "critical".[7] As a consequence of this authority, about a dozen separate clinical and research anesthesiology centers were established in the country's leading hospital and university based departments of anesthesiology. This particular activity provided a crucial impetus and necessary funding in the mid and late 60's not only for basic research but also for clinical investigation in medical anesthesiology.

I have spent considerable time recounting the key factors in research and education involved in the evolution and development of medical anesthesiology as a specialty. In my opinion, there is little doubt that these elements are equally relevant to dental anesthesiology. The sequential developments in medical anesthesiology may give important clues as to when similar events can be expected in our dental sub-specialty. Furthermore leaders in dental anesthesiology should pay particular attention to the essential role that research and research training played during the 1950's and 1960's in medical anesthesiology.

Local Anesthesia Development

Although local anesthesia was discovered and introduced into clinical practice some fifty years after general anesthesia, similar problems had to be faced in its development as a clinical art and a science. The significant points and time relationships regarding research, training, and clinical practice just described in some detail in the narrative account of general anesthesia are also generally applicable to the development of local anesthesia. There are some important differences, however.

One can only be impressed with the significant role played by the dental profession in the development of local anesthesia almost from the time of its discovery in the latter part of the last century. The technical and to some extent the scientific development of local anesthesia by dentists has been something in which the profession can take pride.[3] Following the discovery of Novocaine in 1905 (which was the first clinically safe and practical local anesthetic), there has been a succession of improved local anesthetic agents developed and introduced into dentistry. Although some problems exist with hypersensitivity, occasional toxicity, and the like, improvement in local anesthesia has been progressive and steady. Today's drugs from the standpoint of "analgesia" alone are nearly perfect. In addition, dentists as a group are regarded as clinical experts of both regional and infiltration anesthesia of the mouth and its surrounding structures. Although they administer more than 50 million local anesthetics annually, there is a surprisingly low morbidity and mortality exhibited.[4,8,11]

If local anesthesia is so effective, why then do we still have major difficulties in dental anesthesiology today? The answer from almost all dentists who will admit it and from the hundreds of thousands of potentially terrified patients is that fear and anxiety are as much a part of the overall problem as is pain and the management of pain itself. General anesthesia effectively manages all the components of the pain package but is beset with other inherent difficulties. Local anesthesia no matter how skillfully administered has no direct effect on reducing fear and anxiety. If anything, because a local has to be administered by needles applied intraorally, the problems are intensified in most patients.

Fear and Anxiety

It is significant to recall that as recently as 25 years ago dentistry was frequently regarded by the public with disdain; the profession was held to ridicule in cartoons, comedy sketches and other characterizations of the public mind. It should also be emphasized that as of this date the situation has only slightly improved. This circumstance exists in spite of the fact that dental art and science have kept pace with other complex technological developments of the mid 20th century and the American dentist is universally recognized as the finest in the world.

One reason for this paradox is that pain and dental treatment have long been regarded almost synonymously. This connection has an historical background going back for centuries, related no doubt to images of extraction of the teeth and other crude dental procedures performed with no anesthesia at all. Now that suitable analgesics, devised in the last several decades,

have essentially removed "pain" from the formula, the residual fear and anxiety still remain as a major obstacle to acceptance of dental treatment.

The Influence of the American Dental Society of Anesthesiology

A small group of dentists identified themselves in 1953 as dedicated to the proposition that it is equally important in an overall pain control program to treat the patient's psychological needs as well as his physical and physiological needs. About twenty-five dentists founded the American Dental Society of Anesthesiology (ADSA) slightly over two decades ago; the organization now claims over 2500 members. The ADSA sponsored several national conferences on the educational aspects of pain control in the 1960's and early 70's; the latest of which developed and introduced the now well known *"Guidelines For Teaching the Comprehensive Control of Pain and Anxiety in Dentistry"* officially adopted by the American Dental Association House of Delegates in 1971.[9]

Before the "Guidelines" and the current promotion of modern pain control concepts, few dentists were willing to admit the existence of problems related to anesthesia. After all, safe and effective local analgesic agents were available and the techniques for their administration were well developed. To most dentists it was not very important that large numbers of patients (believed by some to be a majority) did not seek dental treatment voluntarily and often went only as a last resort.[6,10]

The Guidelines were designed to provide the necessary educational experience that would enable the modern dentist to select from "a spectrum" of pain control measures for his patients. This spectrum ranged from local anesthesia at one end to general anesthesia at the other, with inhalation and intravenous sedation occupying the middle range. In this spectrum concept, fear and anxiety are recognized as an integral part of the clinical problem and the treatment is tailored to meet safely the physiological and psychological needs of the individual patient.

The NIDR Ad Hoc Committees 1970-72

The National Institute of Dental Research provided an additional important input to further define the problem areas in dental anesthesiology and to formulate practical solutions. Encouraged by the success of the ADSA national conferences in pointing out not only major educational problems but specific research deficiencies as well, the NIDR entered the picture in 1970 by organizing and convening two separate Ad Hoc Committees on pain control. The individual committees comprised leading teachers, investigators and administrators from both the dental as well as the medical fields.[6,10]

Since the deliberations and recommendations of these two research-oriented committees were concerned with the core of the dental pain control problem some relevant excerpts from the Committee report would seem most appropriate.[6,10,12*]

1. The threat and fear of pain constitutes one of the great obstacles to the acceptance of dental services in the United States, considered by some to be greater than the financial barrier.
2. There is almost total deficit in pain control research at both basic and clinical levels, with respect to general anesthesia, local anesthesia, and psychosedation. A related problem of possibly more immediate importance and severity is the near-absence of adequate undergraduate instruction and training in dental schools dealing with the use of pain control methods that have been available for a considerable period of time. Correcting this deficiency is unquestionably the surest way of bringing early beneficial results to the public.
3. No adequate solution to the overall problem can result without far more effective support of both basic and clinical research in the "pain" area. An entirely new and enlightened educational philosophy and scientific atmosphere is also a prerequisite for teaching and research in this subject in the dental school.
4. Dental anesthesiology as a subspecialty has been grossly neglected in practically all of the dental schools of the country. Although the reasons for the neglect are multiple and complex, one obvious factor is the extreme scarcity of properly trained faculty to provide quality instruction and to conduct meritorious research.
5. For maximum effectiveness, the responsibility for developing and administering programs in research and teaching of pain control should be vested in a single department or division. This division should serve as a central resource to the dental school and its affiliated hospital for clinical management of orofacial pain and all pain control procedures utilized in dental practice.
6. A comprehensive program of teaching and research on the nature and management of pain affords an excellent opportunity for integrating the basic sciences in dental education (pharmacology, physiology, and psychology) with clinical care and research.
7. The guidelines for teaching of pain control in dental schools recently adopted by the American Dental Association (October 1971), were considered a milestone in a belated effort to properly instruct dental students and graduate dentists at all levels of matriculation.

The most far-reaching consideration from a practical standpoint was the Committee's realization that what was actually needed in dental anesthesiology was a totally new breed of academic specialist; a combined clinician, teacher, researcher and administrator.

The necessity for implementing a source of training for this highly trained academician led the NIDR to establish a special grant supported program encompassing most of the recommendations of the Ad Hoc

Committee, as interpreted by top level NIDR staff and adopted officially by the Institute's National Advisory Council.

Unfortunately this particular program was seriously interrupted when the training grant authority of the NIH was substantially altered by a series of administrative and legislative events that occurred in 1973. Even though present NIDR training programs in Pain Control differ somewhat in concept, content and final product, the elements of the special educational program recommended by the Ad Hoc Committees are considered important enough to be restated for additional and future reference.[6,10]

The ideal prerequisites and specific criteria for such specially designed training programs were: A teaching hospital with a strong department of anesthesiology; a close affilation with a progressive dental school; an effective resource in full spectrum pain control for the ambulatory patient; an effective resource in related basic biomedical science, with particular attention to pharmacology and physiology; an effective resource in psychology and related behavioral sciences; and whenever possible, an effective resource in education.

The teacher-investigators prepared in such an intensive program would have had full competence in the entire area of general anesthesia, having participated in the equivalent of a fellowship in the anesthesiology residency program. During their anesthesia experience they would acquire expertise in all phases of outpatient dental anesthesiology, such as general and local anesthesia and intravenous and inhalation sedation. They would develop special competence in the management of all forms of acute and chronic orofacial pain, and acquire the knowledge necessary to understand the psychological aspects of pain as well as proficiency in the management of iatrogenic dental pain. Finally, they would receive extensive post doctoral training which would hopefully lead to the Ph.D. degree in a relevant basic science.

This program was designed to produce academic leaders of the future in the dental anesthesiology field. They would be prepared to direct and provide leadership in the conduct of both basic and clinical research and in teaching and in clinical training.

A majority of the Committee was of the opinion that what was needed was a new specialty in the profession, i.e., dental anesthesiology, and that in the ensuing decades, full academic standing for this specialty would be achieved, similar to that of medical anesthesiology, including certification and all the attendant responsibilities, duties, status, etc.

Many of the important and far reaching recommendations of the Ad Hoc Committee just described would have by this time been accomplished and now be a part of history had there not occurred the rather substantial and restrictive changes in all NIH training grant programs previously mentioned. Substantive disruptions of the one NIDR Pain Control Program designed to implement the foregoing recommendations, were an inevitable consequence. However, the recommendations of the committee were so sound and remain so currently applicable that they have been restated not as a blue print for the 70's as originally intended but as a possible master plan for the future, when efforts are redirected to correct the demonstrated deficiencies.

NIDR's Research Programs

In spite of the disruption in this one specific educationally related activity, a visable effect of the Ad Hoc Committee recommendations and related activities can be seen in the NIDR's current intramural and extramural research programs. The Institute has carried out an intramural research program in clinical dental anesthesiology for almost 25 years. This program, originally devoted to general anesthesia and IV sedation, is now an integral part of an overall and more comprehensive program which includes basic and clinical research in the neurophysiology and the neuropsychology of the pain phenomenon itself. In addition, as a part of a national effort following the Ad Hoc Committee recommendations, the Institute in 1973 established a separate extramural program devoted to pain and pain control research. That program, although only slightly over five years old, is now supporting research and research training activities at a level of almost three million dollars annually. This research activity, although on a much smaller scale, is in general similar in objective to the PHS-NIH-GMS medical anesthesiology grant support programs of the sixties. The NIDR program has already and will no doubt continue to exert a very positive influence on the future development of dental anesthesiology.

Finally, had the recommendations of the Ad Hoc Committee been more fully carried out, the subspecialty of dental anesthesiology would be far healthier and far more advanced towards its ultimate goal of facilitating the provision of full spectrum pain control for the public. This did not occur, however, and we must now accept and operate within the framework of the existing system rather than the one that might have been.

Clinical Problems

It is not generally appreciated that the important clinical problems in dental anesthesiology are related more to the inadequacy of undergraduate and graduate education and training, rather than to an insufficient number or lack of effectiveness in the pain control measures themselves. There are efficient agents and adequate technical procedures available to dentists, ranging from the relatively deep CNS depression of general anesthesia to the less profound intravenous and inhalation sedation techniques and including an impressive array of local anesthetics.

Surprisingly, the fact that adequate drugs, agents and techniques are readily available contributes to current problems in the delivery of quality pain control care rather than mitigating against these same problems. By virtue of the rather liberal provisions of most

state dental practice laws dentists are authorized to administer all of the pain control techniques, including general anesthesia.[13] Traditionally, it is only in the area of general anesthesia that regulations exist relating to special training and experience and these provisions have been developed and administered by the specialty involved. As a general rule, oral surgeons and a relatively few others trained in hospital anesthesiology programs are the only ones conducting general anesthesia in dental practice. These trained professionals, it should be noted parenthetically, are achieving enviable results as far as safety is concerned.[8,11]

A Fellowship in General Anesthesia

The American Dental Society of Anesthesiology recognized that the outstanding safety record in anesthesia achieved by oral surgeons in the last thirty years was directly related to a strict adherence to appropriate training in anesthesiology and a certification of such training by the American Society and the American Board of Oral Surgery. In 1971 the ADSA took an important step to further assure adequate training of dentists and thereby patient safety in the delivery of general anesthesia. The ADSA **Fellowship in General Anesthesia** was established and an invitation was extended to all dentists, both oral surgeons and others, who had at least one year of advanced training and experience in general anesthesia to apply for the Fellowship. In the first few years the ADSA required an oral interview to determine if the candidate's qualifications and experience met the one year training criteria. This simple type of qualifications review was followed in subsequent years by a scientific oral examination. Current indications are that this present certification method will again be revised in the next few years and an even more rigorous oral and written comprehensive examination system will be introduced. The effort to date has been successful and there are presently over 1,500 members of the ADSA with Fellowship in general anesthesia.

The Influence of State Legislation

Because dental practice laws in most states permit the usage of all techniques and procedures necessary to achieve satisfactory results in the practice of dentistry, all pain control modalities are automatically authorized. These liberal practices by the State Boards were made at a time when the only pain control technique available to the general practitioner was local anesthesia and the practice of general anesthesia was relegated to the specialist. Conditions of practice have changed radically in that there are now many pain control modalities available today. However, the rules and regulations with very few exceptions are still on the books as originally written. General anesthesia as has just been mentioned is almost entirely self regulated by the profession through the speciality organizations. A few states have recently established special qualifications with empowering rules and regulations for certification to practice general anesthesia. The State of Ohio, in an exemplary action, has taken the lead in the program for general anesthesia certification. In a special collaborative effort between the profession and the State Board of Dentistry, Ohio has successfully established a certification mechanism with regulations to effectively control the practice of general anesthesia by dentists in that state.[13] Many other states including Alaska, California, Hawaii, Illinois, Maryland, Texas, New York and New Jersey have adopted or are in the process of adopting similar rules and regulations. In my opinion, before too long, all states will require some type of certification of credentials and competency in general anesthesia. In many states such legislation will be promulgated cooperatively with organized dentistry as was the case in Ohio. Unfortunately, in some states there will be punitive legislation with little or no professional input, as has occurred in Alaska and to a lesser degree in Texas.

It has been demonstrated convincingly in the last few years that the state legislatures work effectively and constructively with the dental profession in times when there are no mortalities or other serious cases of anesthetic sequela on the court dockets. However, when law makers work in a crisis situation and media pressures operate, they sometimes overreact and produce harmful legislation. The benefits to be derived from a carefully planned approach rather than pressure induced legislative action are obvious.

Newer Problem Areas

Questions of morbidity and mortality resulting from dental anesthesia are complex ones and have been discussed in some detail in two previous publications.[8,11] We inject the subject into this discourse only for general reference purposes, since these questions are at the core of public safety and related certification issues. While the profession and many of the more progressive States are attempting to correct existing deficiencies in the practice of general anesthesia by a certification mechanism, a similar and closely related public safety problem of some magnitude is being generated with respect to intravenous sedation.

Many of the current difficulties with IV sedation in dental practice exist because of inadequacies in undergraduate teaching. Most schools until very recently have avoided anything more in the curriculum than an introduction to this modality, along with similar introductory courses in general anesthesia. There was the belief and hope that further instruction, experience and training would be given in a postgraduate setting. Since most schools operate under this limited approach (with the notable exception of Loma Linda under the Jorgensen influence and a few others) a very large number of the dentists in this country are relatively uninstructed and untrained in IV sedation. Utilizing their own administrative mechanisms the ASOS and the ADSA through its Fellowship certification program have established specific guidelines for

general anesthesia training. They are thus effectively controlling general anesthesia practice in their joint memberships numbering close to 5,000. So far, for reasons not completely clear, there have been no similar special initiatives taken with respect to IV sedation.

The paradox remains: on the one hand there is a variety of effective IV drugs and techniques available, but on the other the number of dentists properly trained and qualified to utilize these methods is grossly insufficient. At the same time, the desire to use IV methods by these same untrained or partially trained dentists is not matched by a sufficient number of comprehensive training courses designed to assure competence in this area. In this situation, it is indeed surprising that there is not greater pressure to establish some IV sedation certification mechanism. Since a matter of public safety is involved, we can assume that the same legislatures which are looking at the general anesthesia situation are already or soon will be taking a similar look at IV sedation.

The primary element of the problem to be corrected relates to adequate training and experience. During the last few years there has been considerable effort expended in dental schools to correct existing deficiencies at the undergraduate level. Positive results should soon be evident. A more critical problem calling for current attention is the lack of educational and training resources and facilities at the graduate level. Literally thousands of dentists require and are calling for such training.

Obviously, comprehensive courses in intravenous sedation devoting the same amount of time and attention to the subject matter as outlined in the "Guidelines" would be most acceptable. Accordingly, these courses would include appropriate attention to the basic sciences involved, as well as providing full and complete clinical instruction utilizing a sufficient number of patients. Instruction in the management of emergencies potentially involved in anesthetic practice is an indispensable part of any approved graduate or postgraduate course in dental anesthesiology. Of considerable importance also for this type of complete didactic and clinical experience is a final examination to determine understanding and competence. Unfortunately very few graduate courses meet these requirements at this time.

A brief consideration of the profession's "attitude" with respect to the IV issue is of importance. This attitude is at the center of considerations concerning both continuing education and the related certification issue. Many practicing dentists and many equally well meaning but misinformed administrators and faculty believe that IV sedation is merely one step up in the complexity ladder from nitrous oxide inhalation sedation and as such is also simple and without major hazard. I do not share this belief and will devote the final portion of this presentation to some of the more salient differences between the two modalities, particularly as they relate to technical complexity and public safety.

Inhalation Sedation

One of the more salutory developments of the last 25 years has been the rediscovery of nitrous oxide as an effective pain and anxiety control modality. In the mid thirties or early forties a vain attempt to promote nitrous oxide as an anesthetic-analgesic agent proved ill fated. The hopes of many dentists as well as hundreds of thousands of patients who anticipated pain control for operative procedures were raised and then precipitously shattered. For a variety of reasons, N_2O was found to be impractical and ineffective when used for so called "analgesia". The greatest single barrier to such usage was the "excitement stage" which proved extremely difficult if not impossible to manage.

Patients allowed to enter this stage, often injured themselves or otherwise caused serious disruptions to the treatment procedures. If the patients were carried through the excitement stage they would enter the first stage of general anesthesia, with all of its potential problems and difficulties. For a considerable number of patients the "excitement stage" and other related problems with N_2O created a very difficult situation in regard to clinical management and safety.

The concept and technique were therefore thoroughly discredited for the reasons described. Most of the analgesia equipment purchased with such great hope and anticipation was discarded. Little further attention to nitrous oxide as a pain control agent was given until the 1950's. At this time the agent was reevaluated under different circumstances and with an entirely different objective. The techniques were altered to utilize the sedative properties of nitrous oxide rather than its anesthetic-analgesic properties.[14] The "excitement stage" is not a problem with this newer development since it is deliberately and effectively avoided. Even "pre-excitement" is indicative of poor technique, and is to be assiduously shunned. In this manner an extremely safe modality was devised. The patient remains totally conscious, at a level well under the excitement stage, in full control of all protective reflexes and at the same time satisfactorily and effectively sedated. Because of the ease of administration as well as the safety of inhalation sedation, there are now by conservative estimate at least 30,000 dentists using this modality, the great majority of whom have begun using N_2O within the last ten to fifteen years.

It is also clear that inhalation sedation with nitrous oxide is relatively simple in concept and execution and is easy to teach. Clinical proficiency is therefore easily and rapidly achieved. The few minor difficulties relating to the quality and general availability of postgraduate courses in inhalation sedation have been almost completely resolved. The steady influence of the National Analgesia Societies working in concert with the ADSA is credited with effecting the necessary remedial changes in a very few years. Inhalation sedation is probably the safest of all pain control modalities, including local anesthesia itself and as such is not a major problem area in pain control practice today.

IV Sedation

The last pain control modality to be discussed IV Sedation, is one of the most promising. At the same time it would provide as much cause for professional concern as to its safety as does general anesthesia.

As previously mentioned, until very recently general anesthesia was the only method available to completely manage not only the pain of the dental procedures themselves but also the associated fear and anxiety and the distressing memories following the dental operations. This is no longer the case. Now IV sedation using a variety of pharmacological agents provides adequate preoperative, operative and postoperative sedation along with amnesia of varying and controllable degrees. When properly administered in combination with local anesthesia, IV drugs can produce effective pain and anxiety control in a conscious although clinically depressed patient.[17]

With such an effective alternative to general anesthesia, there is little wonder that the practice of oral surgery on ambulatory patients has undergone a major transition in the last 20 years. The all time peak in the use of general anesthesia in dentistry occurred around 1950. It was reported then that in many major cities in this country there were almost as many general anesthetics given in oral surgery offices as there were in the hospitals.[15] As late as 1966 there were still slightly more general anesthetics being administered by oral surgeons than local anesthetics.[8] However, by 1972 a survey of the same group indicated that a reversal had taken place. IV sedation along with local anesthesia was the choice by the same small margin accorded general anesthesia in the '66 survey.[11] For a greater appreciation of the quantitative aspects of general anesthesia and IV sedation usage, it is important to note that approximately 3 million total anesthetic administrations were reported in the 1966 study and slightly over five and one quarter million in 1972. In several very recent unofficial surveys[16] it has been shown that the shift is continuing and now the IV sedation-local combination is clearly the method of choice of a majority of practitioners in the ambulatory practice of oral surgery.

There is little doubt that the overall safety and ease of administration are the two most attractive features of IV sedation. The latter benefit also makes this modality vulnerable to misuse by the untrained and the improperly trained. Both of these characteristics need further discussion for a more complete understanding of the current situation.

First is the matter of safety. Data supporting the safety of IV sedation are often rather glibly quoted by proponents of an "open system" for the instruction and practice of IV techniques, similar to that in use for nitrous oxide inhalation sedation. "Open" in this contest means that any dentist is qualified to enter and progress to a satisfactory completion of the postgraduate or continuing education course by virtue of attendance and little other than limited participation. A closer look at the supporting data shows that most of it is anecdotal, unsupported, and unreliable. In addition, an ASOS survey, the only factual data with respect to the safety of IV sedation has to be more carefully studied for proper evaluation. That survey in 1972[11] did, in fact, report a remarkably low incidence of both morbidity and mortality in IV sedation. The point that must be emphasized, however, is that the survey was conducted on the experience of oral surgeons, recognized as the best trained, most highly qualified dentists in anesthesia in the profession, who in addition are certified by the American Board of Oral Surgery. To expect a similar safety record from dentists who are neither trained, qualified, or certified is naive and unrealistic. Major differences in the relative frequency and nature of complications are at the heart of my conviction that nitrous oxide and IV sedation are in fact two essentially different anesthetic entities realted only in that they are the two most common sedative techniques used in dental anesthesiology.

In inhalation sedation with nitrous oxide the patient is conscious at all times and is separated from deeper anesthetic states by the "excitement stage". This sedation is also completely reversible within a matter of minutes. With regard to morbidity and mortality there has been an experience of over twenty-five years demonstrating a remarkable safety record. There have been no mortalities reported, as far as I am aware, with the exception of several (allegedly) associated with improper plumbing installations of the equipment. These can hardly be blamed on the agent, although dentists must be alerted to this potential mishap, since they have the ultimate responsibility for the patients safety. The morbidity experience has also been exceptionally good, with few complications of any consequence reported.

On the other hand, IV sedation as an anesthetic technique is separated from general anesthesia only by dosage and the individual reaction to that dose. Dosage in itself is not a completely reliable guide because of the not uncommon problems of drug idiosyncrasy, paradoxical and other unpredictable reactions. Although this pain control technique is termed "conscious sedation", it can easily evolve into a "loss of consciousiness" because of the same unusual reactions as in general anesthesia. With intravenous sedation there is no absolute anesthetic level marker to prevent deeper stages. The "excitement stage" protects the patient in N_2O inhalation sedation; there is no such protection in IV sedation. Finally, there is not a 25 year safety experience for IV sedation as there is for N_2O sedation. The same ASOS survey report sometimes used to claim an overall safety experience for IV sedation actually contains specific data which are cause for concern rather than assurance. In answer to a question on serious morbidity "experience", the oral surgeons reported that approximately ⅓ of a total of almost two hundred cases of serious but non-fatal anesthetic complications were associated with IV sedation and local.[11] The "serious complications" reported were chiefly cardiac, cerebral, respiratory or anaphylatic in nature,

in which hospitalization and or cardiopulmonary resuscitation was required. The statement in the report related to the emergency treatment of these complications is important enough to quote: "the present-day well trained oral surgeon directs and participates in resuscitative efforts that prevent complications in the office from going in a potentially tragic direction."[11] Can we expect that these kinds of serious complications will not also occur when less competent and trained dentists are administering the IV sedation? Will the less trained be able to successfully deal with airway, circulatory and other problems routine in the management of such anesthesia which only become serious when neglected or improperly managed? In my estimation this matter is far too important to leave unresolved. The national professional organization, dental schools and others interested and responsible for pain control education and training must exercise a leadership role. After due deliberation, these sources may decide that development of standards and/or certification is necessary to assure the profession and the public that none but the competent will practice IV sedation.

Inhalation sedation is a most valuable pain control modality and one in which both the profession and the public have a stake. Its safe and effective use in the future can only be assured by proper attention to the problems outlined in this paper.

Research in Dental Anesthesiology

I have attempted to discuss in this essay, the evolution of dental anesthesiology in terms of the major problems associated with its fundamental components, research, education — training and clinical practice. Unfortunately it was not possible to devote sufficient time to certain aspects of the subject matter to demonstrate important interrelationships among research and the other elements of the triad. In the earlier parts of this paper we referred to the part that research played in the development of both general and local anesthesia; research progress was described by one writer as the milepost marking the turning point to true professionalism in medical anesthesiology.[5] The cause of research and research training in dental anesthesiology, although dealt a blow by training grant disruptions of the early 70's, is undergoing a modest revival. The beneficial effects of the revival are slowly becoming evident in the clinical area. The general research atmosphere necessary to further the development of professionalism in dental anesthesiology is also emerging now in embryonic form. All of these are positive signs of a slowly developing but healthy evolution.

To conclude this essay I will borrow two quotations from the pen of others, which succinctly and effectively express my own point of view about the central role of research in this discussion.

The first, taken from a recent editorial in *Anesthesiology*: "A discipline not continually engaged in an active and imaginative program of research is dead, will not advance, and will probably deteriorate in general standards and efficiency. It is easy to argue that the main function of our teaching institution is the training of anesthesiologists, and that research is, therefore, not a strictly necessary activity. However, teaching and training when not continually enriched by the leaven of research becomes flat and unimaginative, and eventually fixed in outmoded concepts. Such training discourages original thought and prevents further improvement in patient care".[18]

The second quotation is adopted from a speech of the late Dr. Jack Masur, Assistant Surgeon General-PHS and Director, for a great many years of the Clinical Center, NIH. The statement is beautifully etched in stone at the entrance of the Jack Masur Auditorium, in the Clinical Center, in Bethesda, Maryland: "Hospitals with long traditions of excellence have demonstrated abundantly that *research* enhances the vitality of teaching; *teaching* lifts the standards of service and *service* opens new avenues of investigation."

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BIBLIOGRAPHY

1. Jorgensen NB Jorgensen Papers Vernier Radcliffe Memorial Library Heritage Room Loma Linda University.
2. Hayden J Jr, The Limits of Excellence: What One Man Can Do. Anes Prog 15(3):75 1978.
3. Archer W H *The History of Anesthesia*, Reprinted from the Proceedings of the Dental Centenary Celebration, p. 333-363, March 1940.
4. Seldin H M and Recant B S The safety of anesthesia in the dental office J Oral Surg 13:199 1955.
5. Vandam L D Early American anesthetists the origins of professionalism in anesthesia Anesth 38(3):1264 1973.
6. Report of Ad Hoc Committee I on Research and Faculty Training in Pain Control in Dentistry. National Institute of Dental Research May 1970.
7. Black E A Deming P A Anesthesiology: Its expanding role in medicine. A Research Conference Report DHEW Pub. NO(NIH) 76-918 1974.
8. Proceedings of the Conference on Anesthesia — for the Ambulatory Patient. ASOS 48th Annual Meeting. ASOS Publication 1966: 48.
9. Guidelines for Teaching the Comprehensive Control of Pain and Anxiety in Dentistry — Council on Dental Education, American Dental Association. 1971.
10. Report of Ad Hoc Committee II on Research and Faculty Training in Pain Control in Dentistry. National Institute of Dental Research. 1971 and 1972.

11. ASOS Anesth. Morbidity and Mortality Survey J Oral Surg 32: 1974.
12. Driscoll E J Research and Training in Dental Anesthesiology Symposium on Anesthesia and Analgesia *Dental Clinics of N. America* 17(2):351 1973.
13. Snyder B S The President's Corner (guest editorial) Anes Prog 12(2):35 1975.
14. Langa H *Relative Analgesia in Dental Practice* Inhalation Analgesia with Nitrous Oxide. W B Saunders Co Phila. — 1968.
15. Stubbs D L Anesthesia in Dentistry (an Editorial) Med. Ann. District of Columbia 20:667 1951.
16. Personal Communication: ADSA Com on Fellowship in General Anesthesia. Dr. M. Jaffe Chairman. Exams (74-76).
17. Gelfman S S Gracely R H et al Conscious sedation with intravenous drugs: A Study of Amnesia J Oral Surg 36:191 1978.
18. Kitz R J Biebuyck J F And yet another crisis: research funding in anesthesiology (An Editorial) Anesth 40:3, 211, 1974.